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EFFECT OF SELECTED BOTANICAL EXTRACTS AGAINST *MELOIDOGYNE INCOGNITA* (KOFOID AND WHITE) CHITWOOD ON POTATO (*SOLANUM TUBEROSUM* L.)

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ABSTRACT

An experiment was conducted under glass-house conditions to evaluate the botanical extracts against *Meloidogyne incognita* (Kofoid and White) Chitwood on potato. The use of botanical extracts for the control of nematodes is a very attractive alternative, as aim to decrease the extent of environment degradation and the effect of the excessive toxic nematicides. In the present study, efficacy of botanical extracts of eight plant leaves *viz* marigold (*Tagetes erecta*), drumstick (*Moringa oleifera*), neem (*Azadirachta indica*), guava (*Psidium guajava*), datura (*Datura metel*), sarifa (*Annona reticulata*), chrysanthemum (*Chrysanthemum cinerariaefolium*) and castor (*Ricinus communi*) significantly improved the potato growth parameters in terms of shoot length(cm), root weight (g), root length (cm), length of potato tuber (cm), width of potato tuber (cm), number of tubers and weight of one potato tuber(g) and reduced root-knot infections and reductions in number of galls and number of larvae of the nematode as compared with the untreated plant.

KEYWORDS: Potato, *Meloidogyne incognita*, Botanical Extracts, Carbofuran 3G

INTRODUCTION

Potato (*Solanum tuberosum* L.) is the third most important food crop in world after riceand wheat. It's belongs to family *solanaceae*. There are the main types of vegetables, where the staple food in many regions of the world as it is considered an important alternative for grain whose prices have remarkably increased in recent years, which called many of the nations to pay attention to this development and crop production in order to alleviate the problem of food [1]. Potato is important crop and it can supplement the food needs of the country in a substantial way as it produces more dry-matter food, has well balanced protein and produces more calories from unit area of land and time than other major food crops.Root-knot nematodes, *Meloidogyne* spp. are obligate parasites and very damaging plant pests which limit agricultural productivity. Most cultivated plant species are susceptible to root-knot nematode infection [2]. *Meloidogyne* species cause severe damage in potato (*Solanum tuberosum* L.) worldwide. They can incite direct yield losses or may cause indirect damage in the form of protuberances or blisters on tubers, giving them a warty appearance. These deformations make tubers unmarketable. Potato tubers of Floresta and Bananito clone, with numerous blisters on the tuber surface [3]. The use of botanical extracts for controlling *Meloidogyne* is becoming appealing because of the growing problem of environmental pollution arising from the use of persistent pesticides. Biopesticides are being considered as environmentally safe, selective, biodegradable, economical and renewable alternatives for use in IPM programmes. It is estimated that as many

as 2121 plant species have been reported to posses' pest control properties. Botanicals like neem, ghora-neem, mahogoni, karanja, adathoda, castor, sweet flag, tobacco, annona, smart weed, bar weed, datura, calotropis, drumstick, lantana, chrysanthemum, artemisia, marigold, clerodendrum, wild sunflower and many others may be grown by planters with minimum expense and extracted by indigenous methods. These botanical materials can be used as an alternative to chemical pesticides. These botanical extracts will help in controlling root-knot nematodes. Keeping the above in view the present-experiment was conducted to evaluate the efficacy of certain botanicals against *Meloidogyneincognita* on potato.

MATERIALS AND METHODS

Culturing of *Meloidogyne incognita*

In order to get a large number of second-stage juveniles of *Meloidogyne incognita* for the experiment, the population of the test nematode was developed from a single egg mass on brinjal plants. The required numbers of freshly hatched second-stage juveniles were collected from the pure culture as per the requirement

Sowing of Potato Tubers in Pots

The tubers beds of potato plant were prepared in the pots. Potato tubers variety (KufriBadshah) were sown in earthen pots filled with 5kg soil. The soil was treated with different types of plant leaf extract @ 200 g/pot mixed with FYM 50 g/pot and allowed 15 days for decomposition.

Source of Plant Leaf Extract

Leaves of selected plants *viz* marigold (*Tagetes erecta*), drumstick (*Moringa oleifera*), neem (*Azadirachta indica*), guava (*Pisdiumguajava*), datura (*Datura metel*), sarifa*(Annona reticulate*), chrysanthemum (*Chrysanthemum cinerariafolium*) andcastor (*Riciniscommunis*), were obtained from the University Gardens, Sam Higginbottom Institute of Agriculture, Technology & Sciences, Naini, Allahabad. Chopped plant leaves were treated to the soil@ 200 g/pot.

Inoculation of *M. incognita*

After germination of potato tubers in the pots, pots were divided into eleven groups, each contained three replicate and were arranged in a complete randomized block design, watered and received the normal agricultural practices. The eggs and 2nd stage juvenile (J_2) were obtained from infested brinjal plant roots which were opened by blender through paned the suspension sieve 60 and 300 mesh using method Oosten-brinks-elution [4], the population of *M.incoginta* were inoculated @ 965 J_2 larvae each pot.

RESULTS and DISCUSSIONS

Shoot Length (cm) 30 Days after Inoculation of *Meloidogyne incognita* on Potato

The results presented in table no. 1, shows that when the plants were inoculated with *M.incognita* significant reduction in shoot length were observed in untreated plant with botanical extracts. The shoot length (cm) of potato at 30 days after inoculation with *M. incognita* of the treatments T_9 (Castor), T_0 (Potato alone), T_3 (Drumstick), $T_{2(}$Marigold), T_6(Datura), T_{10}(Carbofuran 3G) and T_4(Neem) significantly increased as compared with T_1 (*M. incognita* alone). Whereas, the treatment T_9 was found significantly increased as compared with T_1, T_7 and T_8. Whereas, the treatment T_0 was found significantly increased as compared with T_1, T_7. Whereas, the treatments (T_9, T_0, T_3, T_2, $T_{6,}$ T_{10}, T_4 and T_5), (T_0, T_3, T_2, T_6, T_{10}, T_4, T_5 and T_8), (T_3, T_2, T_6, T_{10}, T_4, T_5, T_8 and T_7) and (T_5, T_8, T_7 and T1) were found

non-significant from each other. Our findings are also in agreement with the result of [5]observed all the botanicals used for soil amendment posses varying degrees of manurial and antinematode/nematicidal properties. This is evident in the levels of improvement in shoot growth and reduction in number of root galls and nematode egg masses in infected and amended soils. [6] Reported similar reduction in *M. incognita* infection and improved growth of tomato using different green leaf manures.

Shoot Length (cm) 60 Days after Inoculation of *Meloidogyne incognita* on Potato

The results presented in table no. 1, shows that when the plants were inoculated with *M. incognita* significant reduction in shoot length were observed in untreated plant with botanical extracts and Carbofuran 3G (Figure 1). The shoot length (cm) of potato at 60 days afterinoculation with *M. incognita* of the treatments T_0 (Potato alone), T_3 (Drumstick), T_9 (Castor), T_2 (Marigold), T_6 (Datura), T_4 (Neem), T_8 (Chrysanthemum), T_5 (Guava) andT_{10} (Carbofuran 3G) significantly increased as compared with T_1 (*M. incognita* alone).Whereas, the treatment T_0 was found significantly increased as compared with T_8, T_5, T_{10}, $T_7$and T_1.Whereas, the treatments T_3 and T_9 were found significantly increased as comparedwithT_5, T_{10}, T_7 and T_1. Whereas, the treatments T_2 and T_6 were found significantlyincreased as compared with $T_7$and T_1. The treatments (T_0, T_3, T_9, T_2, T_6 and T_4), (T_3, T_9,T_2, T_6, T_4 and T_8), (T_2, T_6, T_4, T_8, T_5 and T_{10}), (T_4, T_8, T_5, T_{10} and T_7) and (T_7 and T_1) were found non-significant among themselves.

Root Length (cm) 90 Days after Inoculation of *Meloidogyne incognita* on Potato

The results of table no. 1, indicates that significantly increase in the root length in treatments T_4 (Neem), T_0 (Potato alone), T_8 (Chrysanthemum), T_7 (Sarifa), T_5 (Guava), T_6 (Datura) and T_{10} (Carbofuran3G) as compared with T_1 (*M. incognita* alone). Whereas, the treatment T_4 was found significantly increased as compared with T_9, T_2, T_3 and T_1. The treatments (T_4, T_0, T_8, T_7, T_5, T_6 and T_{10}), (T_0, T_8, T_7, T_5, T_6, T_{10}, T_9, T_2 and T_3) and (T_2, T_3 and T_1) were found non-significant from each other.

Table 1: Effect of Botanicals on Growth Parameters 90 Days after Inoculation of *Meloidogyne incognita* on Potato

S. N	Treatments	Shoot Length (cm) 30 d.a.i	Shoot Length (cm) 60 d.a.i	Root length (cm) 90 d.a.i	Root Weight (g) 90 d.a.i	Number of Potato Tubers 90 d.a.i	Weight of One Potato Tuber(g) 90d.a.i	Length of Potato Tubers (cm) 90 d.a.i	Width of Potato Tubers (cm) 90 d.a.i
T_0	Potato alone	37.33	49.67	16.67	10.00	9.33	32.33	6.50	4.17
T_1	*M.incognita*	25.00	32.33	11.00	4.67	5.00	14.00	2.33	1.67
T_2	Marigold	36.00	46.67	14.00	7.50	6.67	22.00	5.50	3.83
T_3	Drumstick	36.00	48.67	14.00	8.00	6.00	23.33	5.67	3.67
T_4	Neem	33.33	43.33	17.67	10.00	8.00	25.67	5.00	3.33
T_5	Guava	31.67	40.67	15.67	8.67	5.67	19.33	4.83	3.33
T_6	Datura	34.00	45.00	15.33	8.83	9.00	27.00	4.83	3.17
T_7	Sarifa	30.00	37.33	15.67	7.67	6.33	22.67	5.00	3.50
T_8	Chrysanthemum	30.67	42.66	15.66	10.67	6.67	23.33	5.83	3.83
T_9	Castor	38.33	48.66	14.33	8.50	7.00	22.00	5.33	3.83
T_{10}	Carbofuran 3G	33.67	40.00	15.00	8.83	7.00	23.67	4.83	3.00
	C. D. (P = 0.05)	7.312	6.688	3.328	2.887	1.953	5.532	1.156	0.653

Root Weight (g) 90 Days after Inoculation of *Meloidogyne incognita* on Potato

The results of table no. 1, indicates that significantly increase in the root weight in treatments T_8 (Chrysanthemum), T_0 (Potato alone), T_4 (Neem), T_6 (Datura), T_{10} (Carbofuran 3G), T_5 (Guava), T_9 (castor) and

T_3 (Drumstick) Respectively as compared with T_1 (*M. incognita* alone). Whereas, the treatment T_8 was found significantly increased as compared with T_7, T_2 and T_1. The treatments (T_8, T_0, T_4, T_6, T_{10}, T_5, T_9 and T_3), (T_0, T_4, T_6, T_{10}, T_5, T_9, T_3, T_7 and T_2) and (T_2 and T_1)were found non-significant from each other.

Figure 1: Effect of Some Botanical Extracts on the Shoot Length (cm) of Potato

Number of Potato Tubers 90 Days after Inoculation of *Meloidogyne incognita* on Potato

There was significant increase in the number of potato tubers in treatmentsT_0 (Potato alone), T_6 (Datura), T_4 (Neem), T_{10} (Carbofuran3G) and T_9 (castor) Respectively as compared with T_1 (*M. incognita* alone). Whereas, the treatments T_0 and T_6 were found significantly increased from T_{10}, T_9, T_8, T_2, T_7, T_3, T_5 and T_1. Whereas, the treatment T_4 was found significantly increased from T_3, T_5 and T_1. The treatments (T_0, T_6 and T_4), (T_4, T_{10}, T_9, T_8, T_2 and T_7), (T_{10}, T_9, T_8,T_2, T_7, T_3 and T_5), (T_8,T_2, T_7, T_3, T_5 and T_1) were found non-significant from each other. Our findings are also in agreement with the result of [7] several reports found that neem extracts and some plants enhanced the plant growth, and increased the yield in different crops [8-9-10-11].

Weight of One Potato Tuber 90 Days after Inoculation of *Meloidogyne incognita* on Potato

There was significant increase in the weightof one potato tubers in treatments T_0 (Potato alone), T_6 (Datura), T_4 (Neem), T_{10} (Carbofuran3G), T_3 (Drumstick), T_8 (Chrysanthemum), T_7 (Sarifa), T_9 (castor) and T_2 (Marigold) as compared with T_1 (*M. incognita* alone). Whereas, the treatment T_0 was found significantly increased from T_4, T_{10}, T_3, T_8, T_7, T_9, T_2, T_5, T_1.Whereas, the treatmentsT_6 and T_4 were found significantly increased from T_5 and T_1. The treatments (T_0 and T_6), (T_6, T_4,,T_{10}, T_3, T_8, T_7, T_9 and T_2), (T_{10}, T_3, T_8, T_7, T_9, T_2 and T_5), (T_5 and T_1) were found non-significant from each other.Our findings are also in agreement with the result of[1]observed weight of tubers in the application of *D. stramonium* gave the highest value. Several reports found that neem extracts and some plants enhanced the plant growth, and increased the yield in different crops [7-8-9-10-11].

Length of Potato Tuber 90 Days after Inoculation of *Meloidogyne incognita* on Potato

There was significant increase in the length of potato tuber (cm) in treatments T_0 (Potato alone), T_8(Chrysanthemum), T_3 (Drumstick), T_2 (Marigold), T_9 (castor), T_4 (Neem), T_7 (Sarifa), T_6 (Datura), T_{10} (Carbofuran 3G) and T_5 (Guava) as compared with T_1(*M. incognita* alone). Whereas, the treatment T_0 was found significantly increased from T_9, T_4, T_7, T_6, T_{10}, T_5 and T_1. The treatments (T_0, T_8, T_3 and T_2) and (T_8, T_3, T_2, T_9, T_4, T_7, T_6, T_{10} and T_5) were found non-significant from each other.

Width of Potato Tuber 90 Days after Inoculation of *Meloidogyne incognita* on Potato

There was significant increase in the width of potato tuber (cm) in treatments T_0 (Potato alone), T_9 (castor), T_8 (Chrysanthemum), T_2 (Marigold), T_3 (Drumstick), T_7 (Sarifa), T_4 (Neem), T_5 (Guava), T_6 (Datura) and T_{10}(Carbofuran 3G), as compared with T_1(*M. incognita* alone). Whereas, the treatment T_0 was found significantly increased from T_7, T_4, T_5, T_6, T_{10} and T_1. Whereas, the treatments T_9, T_8 and T_2 were found significantly increased from T_6, T_{10} and T_1. Whereas, the treatment T_3 was found significantly increased from T_{10} and T_1. The treatments (T_0, T_9, T_8, T_2 and T_3), (T_9, T_8, T_2, T_3, T_7, T_4 and T_5), (T_3, T_7,T_4, T_5 and T_6) and (T_7,T_4, T_5, T_6 and T_{10}) were found non-significant from each other.

Number of Root-Knot/Plant 90 Days after Inoculation of *Meloidogyne incognita* on Potato

The results of table no. 2, indicates that significant reduction inthe number of root-knot in treatments T_0 (potato alone), T_{10} (Carbofuran 3G), T_4 (Neem), T_6 (Datura), T_7 (Sarifa), T_9 (castor), T_2 (Marigold), T_8 (Chrysanthemum), T_3 (Drumstick) and T_5 (Guava) Respectively as compared with T_1 (*M. incognita* alone). Whereas, the treatment T_0 was found Significant difference from T_{10},T_4, T_6, T_7, T_9, T_2, T_8, T_3, T_5, T_1. Whereas, the treatment T_{10} was found Significant difference from T_6, T_7, T_9, T_2, T_8, T_3, T_5, T_1. Whereas, the treatment T_4 was found Significant difference from T_2, T_8, T_3, T_5

and T_1 .Whereas, the treatments T_6, T_7, T_9 and T_2 were found Significant difference from T_5 and T_1.The treatments (T_{10} and T_4), (T_4, T_6, T_7 and T_9), (T_6, T_7, T_9, T_2, T_8 and T_3) and (T_8, T_3 and T_5) were found non-significant from each other. Our findings are also in agreement with the previous coworkers who [12] reported thatall the amendments with plant leaves in soil caused significant reductions in the number of galls, the most significant reductions were with *A. indica* and *D. stramonium*.

They reported that nematode populations may be reduced due to the accumulation of toxic substances that are produced by the decomposition of organic amendments in soil [13-14].[15]Two hypotheses there also postulated, which explain the effectiveness of soil amendments in two ways. The decomposition products from soil amendments are directly toxic to plant nematodes, and manipulation of soil microbial populations by the addition of amendments initiates a cascade of events favoring the build-up of bacteria,microbivorers, nematode-trapping fungi and other soil antagonists that destroy parasitic nematodes.

Table 2: Effect of Botanicals on Nematodes Population 90 days after Inoculation of *Meloidogyne incognita* on Potato

S.N.	Treatments	Number of Galls/Plant	Number of Larvae in Root System
T_0	Potato alone	0.00	0.00
T_1	*M.incognita*	78.00	1066.67
T_2	Marigold	46.67	346.67
T_3	Drumstick	50.67	373.33
T_4	Neem	38.67	320.00
T_5	Guava	54.67	413.33
T_6	Datura	43.67	326.67
T_7	Sarifa	45.33	333.33
T_8	Chrysanthemum	49.33	366.67
T_9	Castor	45.67	340.00
T_{10}	Carbofuran 3G	31.67	220.00
	C. D. (P = 0.05)	7.229	53.666

Number of Larvaein Root System of Potato Plant at 90 Days after Inoculation of *Meloidogyne incognita*

The results of table no. 2, indicate that number of *M. incognita* larvae in 1ml of potato rootsuspensionwere significantly reduced in the treatment of Carbofuran 3G as compared with other treatments. But in T_4 (Neem), T_6 (Datura), T_7 (Sarifa), T_9 (Castor), T_2 (Marigold), T_3 (Chrysanthemum), T_3 (Drumstick) and T_5 (Guava) significant reduction in number of larvae was observedas compared with (*M. incognita* alone).Whereas, the treatment $T_4$was found significant different fromT_3, T_5 and T_1. Whereas, the treatment T_6, T_7, T_9 and T_2 were found significantly different from T_5 and T_1. The treatments (T_4, T_6, T_7, T_9, T_2 and T_8), (T_6, T_7, T_9, T_2, T_8 and T_3) and (T_8, T_3 and T_5) were found non-significant from each other.

Our findings are also in agreement with the result of [12]reported that nematode populations may be reduced due to the accumulation of toxic substances that are produced by the decomposition of organic amendments in soil[13-14].[15] postulated two hypotheses, which explain the effectiveness of soil amendments in two ways. The decomposition products from soil amendments are directly toxic to plant nematodes, and manipulation of soil microbial populations by the addition of amendments initiates a cascade of events favoring the build-up of bacteria,microbivorers, nematode-trapping fungi and other soil antagonists that destroy parasitic nematodes.

REFERENCES

1. **Khalil, A. E. and Shawky, S.M. (2008).** Combination of the nematophagous fungus *Paecilomyceslilacinus* and aqueous leaf extracts in controlling *Meloidogynejavanica* infecting potato. *Egypt.J. Agronematol*, 6 (2): 185 – 196.
2. **Sasser, J.N. and Carter C.C. (1985).** An Advanced Treatise on *Meloidogyne*, Biology and Control. Vol 1. North Carolina State University Graphics, 422 pp.
3. **Zeidy Montero, Catalina García, Luis Salazar, Roberto Valverde and Luis Gomez-Alpizar (2007).** Detección de *Meloidogyne incognita* en tubérculos de papa en costa rica. *AgronomíaCostarricense*, 31(1): 77-84.
4. **Pang, R. S. and Sivagami, V. (2009).** Pathogenicity of root-knot nematode on onion. *International Nematology Network Newsletter*, 6:11-13.
5. **Onyeke, C.C. and Akueshi, C.O. (2012).** Infectivity and reproduction of *Meloidogyne incognita* (Kofoid and White) Chitwood on African yam bean, *Sphenostylisstenocarpa* (Hochst*Ex*. A. Rich) Harms accessions as influenced by botanical soil amendments. *African Journal of Biotechnology*, 11(67):13095-13103.
6. **Pakeerathan, K., Mikunthan, G. and Tharshani, N. (2009).**Eco-friendly management of root-knot nematode *Meloidogyne incognita* (Kofid and White) chitwood using different green leaf manures on tomato under field conditions.*American-Eurasian J. Agric. & Environ. Sci*, 6 (5): 494-497.
7. **Khalil, M.S.H., Allam, A.F.G. and Barakat, A.S.T. (2012).** Nematicidal activity of some biopesticide agents and microorganisms against root-knot nematode on tomato plants under greenhouse conditions. *Journal of Plant Protection Research*, 52: 47-52.
8. **Saad, A.S.A., Massoud, M.A., Ibrahim, H.S. and Khalil, M.S. (2012).** Activity of nemathorin, natural product and bioproducts against root-knot nematodes on tomatoes. *Archives* of *Phytopathology and Plant Protection*, 45: 955-962.
9. **Khan, M.R., Solanki, R.D., Bohra, B. and Vyas, B.N. (2012).** Evaluation of Achook (Azadirachtin 1500 ppm) against root knot nematode (*Meloidogyne incognita*) infecting okra. *South Asian Journal of Experimental Biology*, 2: 149-156.
10. **Trifonova, Z. and Atansov, A. (2011).** Control of potato cyst nematode *Globoderarostichiensis* with some plant extracts and neem products. *Bulgarian J AgricSci*, 17: 623-627.
11. **Agbenin, N. O., Emechebe, A. M., Marley, P. S. and Akpa, A. D. (2005).** Evaluation of nematicidal action of some botanicals on *Meloidogyne incognita* in vivo and in vitro. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 106(1): 29-39.
12. **Muhammad ArshadHussain, Tariq Mukhtar and Muhammad ZameerKayani (2011).** Efficacy evaluation of *Azadirachta indica, Calotropisprocera, Daturastramonium* and *Tagetes erecta* against root-knot nematodes *Meloidogyne Incognita*. *Pak. J. Bot*, 43: 197-204.
13. **Akhtar, H., Khan, A.M. and Saxena, S.K. (1982).** Toxicity of latex bearing plants to phytonematodes. *Ind. J. Parasitol*., 6: 119-120.

14. **Khan, A.M., Adhami, A. Z., Siddiqui, A. and Saxena, S.K. (1966).** Effect of different oil cakes on hatching of larvae and on development of root-knot caused by *Meloidogyne incognita*. *Acta Bot. Indica*, 10: 124-127.

15. **Sayre, R.M. (1980).** Promising organism for bio-control of nematodes. *Plant Dis*., 64: 527-532.